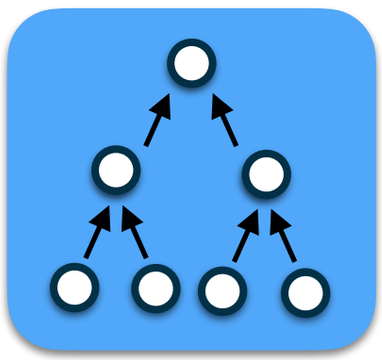
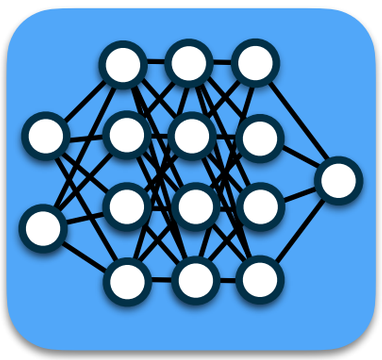
August 10, 2020

Welcome to the Snowmass Computational Frontier Workshop

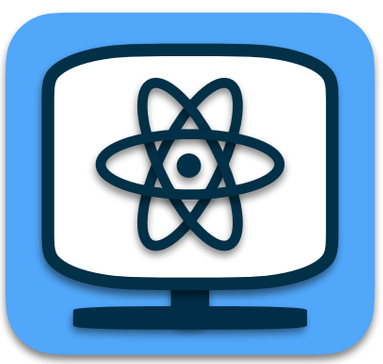
Steve Gottlieb
Indiana University

Oli Gutsche
Fermilab

Ben Nachman
Lawrence Berkeley National Laboratory



Snowmass

Snowmass = Particle Physics Community Planning Exercise

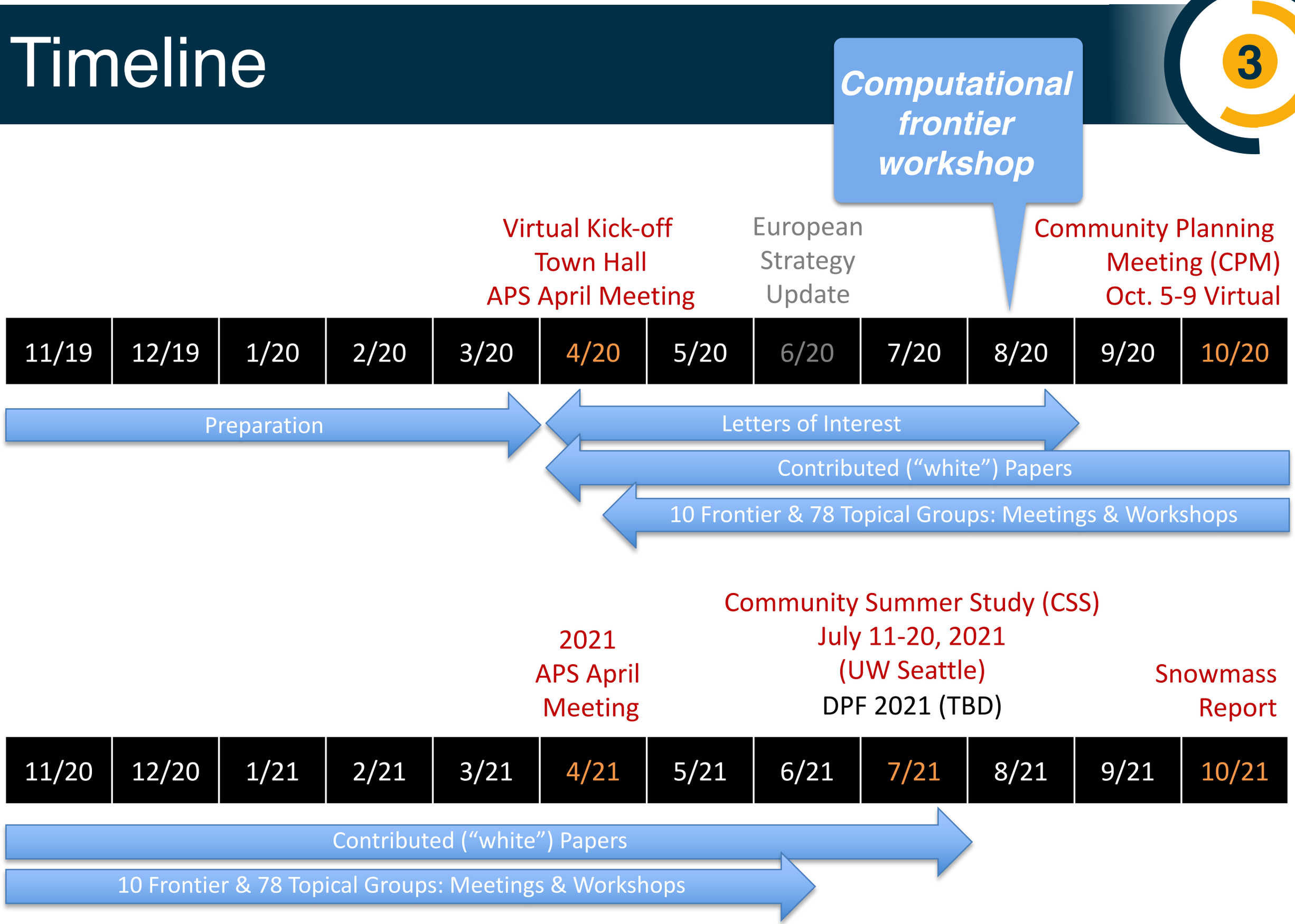
- Goals
  - To define the most important questions for the field of particle physics
  - To identify promising opportunities to address them

- Do & Do-Not
  - Do: Address the questions the particle physics community wants to answer over the next two decades and how we plan to answer them
  - Do-Not: Prioritize activities (this is the goal of the P5)

- The Snowmass process could include
  - Develop a framework of scientific questions that can form the basis of a future program
  - Survey experiments, facilities, and capabilities that would address these questions

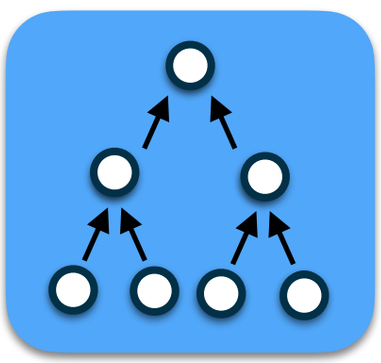
from Young-Kee Kim, DPF chair

Timeline



from Young-Kee Kim, DPF chair

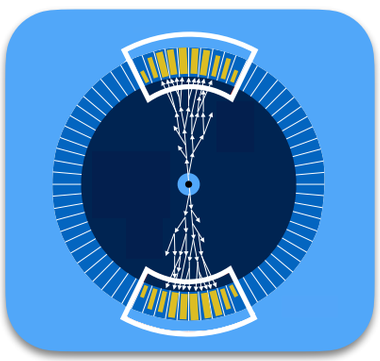
Computational Frontier Organization



CompF01

Experimental Algorithm Parallelization

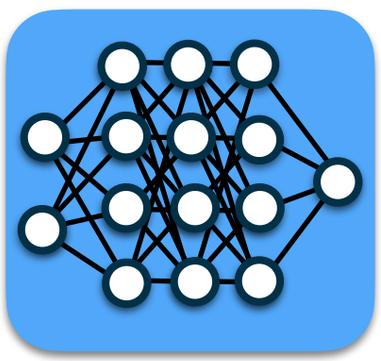
Guiseppi Cerati (FNAL), Katrin Heitmann (ANL), Walter Hopkins (ANL)



CompF02

Theory Calculations & Simulation

Peter Boyle (BNL), Daniel Elvira (FNAL), Ji Qiang (LBNL)



CompF03

Machine Learning

Phiala Shanahan (MIT), Kazu Terao (SLAC), Daniel Whiteson (Irvine)

CompF04

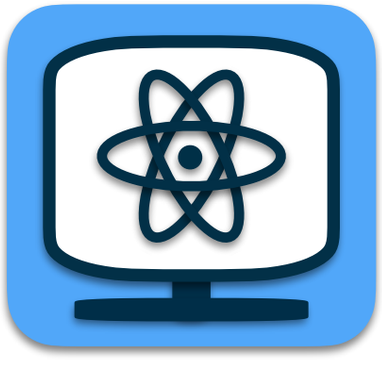
Storage and Processing Resource Access
(Facility and Infrastructure R&D)

Wahid Bhimji (NERSC), Rob Gardner (U. Chicago), Frank Würthwein (UCSD)

CompF05

End User Analysis

Gavin Davis (U. Mississippi), Peter Onyisi (U. Texas at Austin), Amy Roberts (UC Denver)



CompF06

Quantum Computing

Travis Humble (ORNL), Gabriel Perdue (FNAL), Martin Savage (U. Washington)

CompF07

Reinterpretation & Long-term Preservation of Data and Code

Kyle Cranmer (NYU), Mike Hildreth (Notre Dame), Matias Carrasco Kind (Illinois/NCSA)

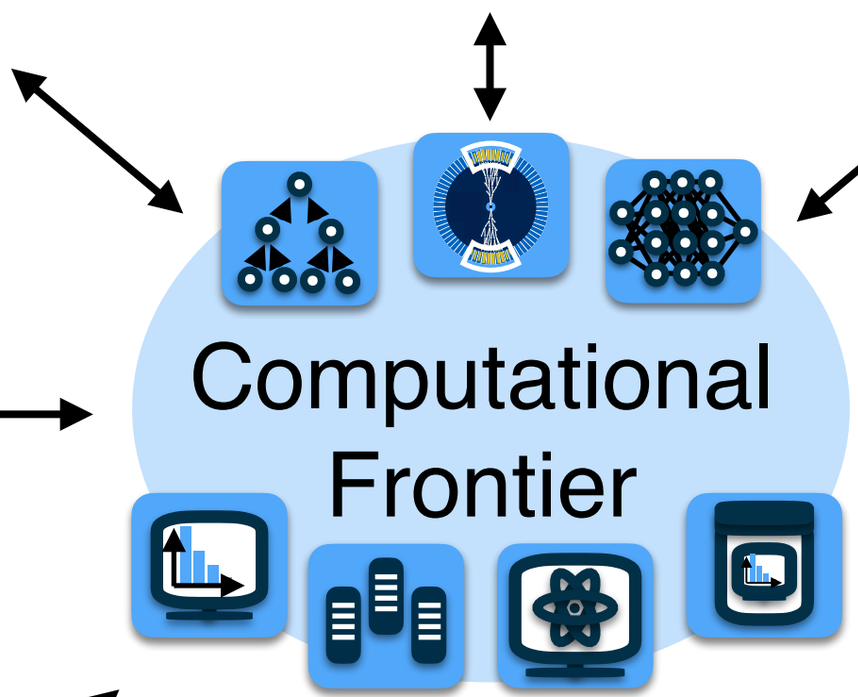
Liaisons

Energy Frontier
Daniel Elvira (FNAL)

Neutrino Frontier
Alex Himmel (FNAL)

Rare Processes & Precision
Stefan Meinel (Arizona)

Cosmic Frontier
Deborah Bard (NERSC)
Brian Yanny (FNAL)



Theory Frontier
Steven Gottlieb (Indiana)

Accelerator Science/Technology
Jean-Luc Vay (LBNL)

Instrumentation Frontier
Darin Acosta (Florida)

Community Engagement
David Bruhwiler (RadiaSoft)

Communication

https://snowmass21.org/computational/start

SnowMass2021

- WELCOME PAGE
- ANNOUNCEMENTS
- SNOWMASS CALENDAR
- ETHICS GUIDELINES

- Organization

- SNOWMASS ADVISORY GROUP
- SNOWMASS STEERING GROUP
- FRONTIER CONVENERS

COMPUTATIONAL FRONTIER

Software and Computing are an integral part of the science process. High Energy Physics traditionally had the largest computing resource needs and subsequently most complex software stack in science. This is not true anymore, with many other science domains predicting equal or larger resource needs. The Computational Frontier will assess the software and computing needs of the High Energy Physics community emphasizing common needs and common solutions across the frontiers. We want to gain an overall understanding of the community's needs and discuss common solutions to them in the context of current and future solutions from the HEP community, other science disciplines and industry solutions. Our focus is to facilitate discussions amongst all frontiers and don't separate them into individual groups.

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- COMPUTATIONAL FRONTIER
  - Frontier Conveners
  - Topical groups
  - Bibliography
  - Liaisons
  - Meetings
  - Submitted LOI

Join our Slack channels!

comp_frontier_topics
compf01-expalgos
compf02-theorycalcsim
compf03-ml
compf04-storeandprocess
compf05-useranalysis
compf06-quantum
compf07-preservation

Join our topical group meetings!

indico

Join our email lists!

Topical groups

Name	Email List	Slack Channel
CompF1: Experimental Algorithm Parallelization	snowmass-compf01-expalgos[at]fnal.gov	#compf01-expalgos
CompF2: Theoretical Calculations and Simulation	snowmass-compf02-theorycalcsim[at]fnal.gov	#compf02-theorycalcsim
CompF3: Machine Learning	snowmass-compf03-ml[at]fnal.gov	#compf03-ml
CompF4: Storage and processing resource access (Facility and Infrastructure R&D)	snowmass-compf04-storeandprocess[at]fnal.gov	#compf04-storeandprocess
CompF5: End user analysis	snowmass-compf05-useranalysis[at]fnal.gov	#compf05-useranalysis
CompF6: Quantum computing	snowmass-compf06-quantum[at]fnal.gov	#compf06-quantum
CompF7: Reinterpretation and long-term preservation of data and code	snowmass-compf07-preservation[at]fnal.gov	#compf07-preservation

- Instructions to join a mailing list
- Instructions to join the Snowmass2021 Slack (at the end of the page)

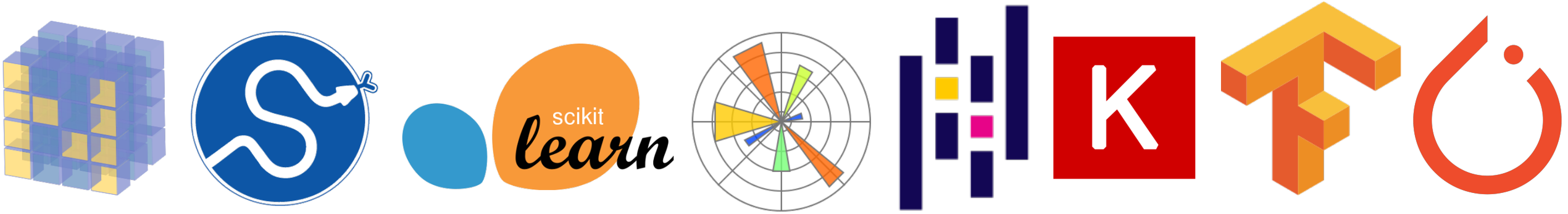
Computational Frontier Scope

Our main time horizon should be ~10 years (HL-LHC, DUNE, LSST, etc.), but it is also useful to think about the next-to-next experiments and what R&D/funding opportunities we may need to be ready for the computing of the future.

Example: Scientific Tools

The software stack used by a typical HEP analyzer has dramatically changed.

While ROOT used to be the one-stop-shop for many analyses, now there is a mix of NumPy, SciPy, scikit-learn, Matplotlib, pandas, Keras, TensorFlow, PyTorch, …



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Since the last Snowmass, we have moved mostly from C++ to Python. Will that change in the next 10 years? (Python to Julia?)

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Since the last Snowmass, we have moved mostly from C++ to Python. Will that change in the next 10 years? (Python to Julia?)

Should HEP be paying for developers of these packages / languages? What role does ROOT play in our future?

Time to “Think Big”

We should not be afraid to think about O(1) challenges and solutions to the physics of our future.

Relevant for theorists & experimentalists!

Some things to think about:

- Quantum computing was not part of the last Snowmass and machine learning was only briefly mentioned.
- Computing of the future will likely be much more heterogenous than the computing of today.
- The “intensity” and cosmic frontiers will soon have comparable data challenges to the energy frontier.
- Computing is a catalyst for building bridges to other areas of science and society at large.

Code of conduct

We strive to build an inclusive, welcoming environment.
Harassment in any form will not be tolerated.
We will abide by the APS code of conduct:

https://www.aps.org/meetings/policies/code-conduct.cfm

Complaints can be sent to any of the workshop organizers.

We will use Zoom features like "raise hand" -
please respect everyone's opportunity to participate.

You can also add questions to the live notes. If you do this, please put them in a ***different color*** *so we don't miss them!*

Workshop Agenda

Timetable

Mon 10/08 | Tue 11/08 | All days

Print | PDF | Full screen | Detailed view | Filter

Introduction
10:00 - 11:30

Break
11:30 - 12:00

Connections Between Frontiers
12:00 - 13:30

Break
13:30 - 14:00

CompF1: Experimental Algorithm Parallelization
Giuseppe Cerati, Katrin ...
14:00 - 15:30

CompF2: Theoretical Calculations and Simulation
Daniel Elvira, Pet...
14:00 - 15:30

CompF3: Machine Learning
Daniel Whiteson, Kazuhiro Terao, ...
14:00 - 15:30

CompF4: Storage and processing resource access (Facility and Infrastructure R&D)
14:00 - 15:30

CompF5: End user analysis
Amy Roberts, Gavin ...
Zoom

CompF6: Quantum computing
Gabriel Perdue, Martin...
14:00 - 15:30

CompF7: Reinterpretation and long-term preservation of data and code
Kyle Cranmer, Matias Carr...
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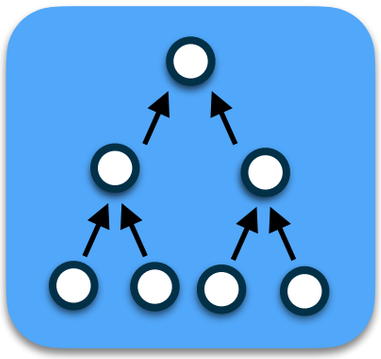
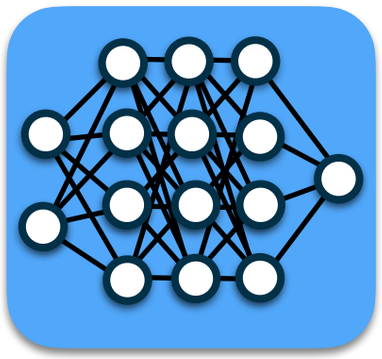
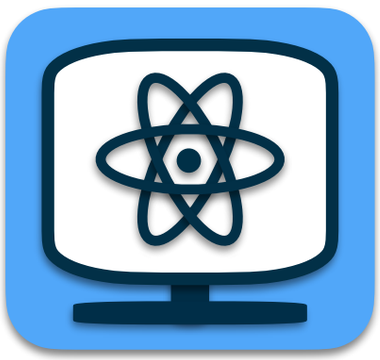
Summary and Outlook
15:30 - 17:00



Looking forward to a productive workshop!